# KING'S PATENT SPLINTS

AND

# LIMB-STRAIGHTENERS.



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The advantages claimed for these over other appliances for the same purposes, hitherto in use, are as follows:

*I. For Fractured and Crooked Long Bones.*

From the time when the first crude Splinter of wood or tree-bark was applied to a fractured limb, to protect the soft part surrounding the bone or bones from being torn and worried by the fractured ends of the bone or bones, by preventing movements of the limb upon a false point of motion, various improvements in devices and materials have been used to secure this end. The first advance was naturally enough to increase the breadth of the Splinter so as to give larger bearings; this necessitated, next, the adapting of the Splinter to the shape of the limb, to avoid undue pressure on limited portions of the surface, which was found by prolonged co-aptation to interrupt the circulation of blood through the limb, to cramp the muscles pressed upon and impair the nervous tone of the skin, giving rise in the first case to gangreen and loss of the lower part of the limb;

in the second, to spasmodic action and disadjustment of the bone or bones, besides pains and restlessness to the patient; and in the third case, to ulcerations of the skin, reducing simple fracture to compound, by admitting air to the cavity of the fracture, a condition much the more obstinate to treat and the more likely to prove fatal to life or limb. Not to go through all the stages through which this end has been sought, including the imperfect and costly wooden carved Splints, wire gauge, gutta percha, shaped by the aid of hot water, (which is liable to return to a plane when released by the heat of the limb,) sap-wood shaped by steam, (liable to corrugate by the effects of moisture,) the convenient but homely starch bandage, and lastly liquid glass painted over the limb in consecutive layers, it is sufficient to know that the difficulty giving rise to all this ingenuity lies in the desideration of some material which shall combine the following properties, viz: 1st, plentifulness; 2d, plasticity to be wrought easily into the desired shape; 3d, consistency to retain that shape permanently, against all opposing agencies when once assumed; 4th, cheapness, and 5th, accessibility.

None will deny the assertion, that the difficulty in making boots to fit the feet comfortably when new, arises not from imperfection in the construction of human feet, but from the incompetency of art to imitate nature perfectly. Then the simplest and shortest road to the end in the question of Splints, is to mould them from nature herself. This, the properties of vulcanized rubber now enables us to do. On the point of its plentiful supply, the Scientific American, published in New York city, has the following paragraph, page 269, of its weekly issue of April 23d, 1870: "There are in America and Europe more than 250 manufactories of rubber articles, employing some 500 operatives each, and consuming more than 20,000,000 lbs.

of gum per year." This is enough to settle that question. Vulcanized India Rubber is prepared by the addition of sulpher to *caoutchouc*, and delivering it in sheets of convenient dimensions, as plastic as wax at summer temperature, and these separated by leaves of linen cloth, are put upon the market ready to be made into any shaped articles desired, by encasing them in moulds of plaster-of-Paris, and subjecting the whole under pressure, to certain degrees of heat for a certain length of time, according to the hardness and spring required. It has the singular property which no other tempered material has, that when it is desired to alter the shape, after it has been tempered as above, it may be made soft and pliable by cautiously applying heat from an alchohol or gas flame, it being well greased to prevent the outside being burnt by too sudden application of the heat, and on cooling, will recover its temper in any shape it is held in, while if not held in any other shape it will recover the form of its mould as it recovers its temper. It has another property which adds greatly to its beauty, that of receiving a high polish; this would seem superfluous to mention, since the public are in constant use of so many beautiful and useful articles made of it, such as canes, combs, jewelry, &c., but unfortunately there is a pretty general popular error in supposing that these article are made of gutta percha; gutta percha is never used in this form, not bearing the action of heat and moisture so well.

The claims, then, of Vulcanized India Rubber to the second and third properties required, to repeat, plasticity and consistency, are established by the simple statement of its properties. On the head of its cheapness, it is claimed that, while the raw material is nominally more expensive than wood, starch and linen, and may be, than liquid glass, the lightness and the even hardness of India

Rubber, and its capability of taking any mould, allowing a very little to go a great way, encasing a whole limb with equal pressure, as contrasted with the necessary clumsiness of wood, owing to the weakness of its grain, the very limited deflection of form it can be forced into by all the appliances brought to bear on it, the expense of carving it, and its imperfection of shape when carved, rendering it dangerous to life and limb by unequal pressure, throw the advantages so much in favor of the India Rubber that it is claimed that Splints made of this material can be furnished, without the clasps, as cheap as those of wood, with all the superiority of the article thrown in, and with the clasps, at an advance of a few dollars more on the dozen; while the fact that the extension of the Goodyear patent for the manufacture of the raw material expires on the sixth of May, 1872, will so cheapen and increase the supply, the right of manufacture then being public property, that the difference of expense will cease to be a consideration. Already, in the experience of getting up the models, it has been found to be so cheap as to stand in no comparison to the expense of doctor's bills for treatment of fractures and crooked legs.

The last and most important property, viz: accessibility to the public when needed, is the one upon which the practical value of the invention most depends. Let us see if it meets this desideratum. The first step the manufacturer has to take is, to take plaster-of-Paris moulds from living legs, of such various sizes and sections of the limbs as are likely to be called; for this once done, to obtain living models would seem no great job. When a single advertisement in a large city will generally call together two or three hundred applicants for a single store clerkship, the plaster busts can be duplicated to the end of all time from the working models vulcanized upon

these original models; thus supplied, (each size numbered and each section named,) to the various surgical instrument depots and prominent drug stores throughout the country, any surgeon in any city, upon taking charge of a patient with a fractured or bent limb, may, upon sending to the nearest enterprising druggist or instrument maker the length and circumference of the fellow-limb, obtain a complete encasement for the affected limb, with or without the patent graduated fastenings, as he should elect, with as much ease as he could obtain any other prescription, or a pair of shoes of a given number; with the advantage over the shoes, that, being in two pieces, and adjustable, the question of exact size would be out of the way; the fit, too, being secured by the fact of legs and arms being unlike the feet and hands, largely made up of soft parts, so that any Splint of the mean dimensions, modeled from one living limb, should fit, to all purposes of surgery, the curves and angles of any other corresponding limb of like mean dimensions.

The question whether these Splints would be kept on hand, whenever and wherever needed, is to be decided by the demand, and the capacity of the improvement in question to satisfy that demand. No one need be told that the demand for Splints and pratical Leg-Straiteners will never cease, as long as man continues to suffer from the fall of our first parents; and if these improvements embody the advantage hereinafter claimed for them, over all other materials and apparatuses heretofore put upon the market for these purposes, there is no fear that the laws of supply and demand will fail to operate in their favor.

The advantages of the material of Spring Hard Rubber, used as Splints and Limb-Straiteners, (for which the letters patents have been granted,) over all competition being

established, we now proceed to consider the advantages of the patent fastenings.

While the Splints without them furnish a more complete, light, and convenient apparatus for the setting of broken bones, than any other in the market, and as cheap or cheaper, the addition of these, at a small advance in the cost, secures several mechanical advantages of no inconsiderable surgical importance.

1st. They do away with external bandages in treatment of fracture, relieving the surgeon of much trouble in applying and removing them, being more readily unfastened for inspection or relief of pressure.

2d. Once fastened, they cannot slip or loosen, which the most skilfully applied bandage does usually.

3d. The under half operates as a comfortable bed for a limb with compound fracture, or where the soft parts have been opened by surgical operation; and the upper half serving as a cope may be lifted off. The "many tailed" bandage, used as the under dressing in these cases, may then be raised at its ends to inspect the progress of healing, without removing the lower Splint.

4th. When old age or debility of constitution forbids the attempt to extend the limb to its normal length by the usual means, these Splints may be padded under the ends, where they bear upon the bones of the joints clear of the blood-vessels and nerves, so that all pressure will be taken off the soft parts, and the graduated clasps may be so tightened as to maintain any degree of "extension and counter-extension," consistent with safety, and this even in some cases where "extension and counter-extension" would not otherwise be attempted.

5th. The graduated clasps are so arranged that they allow the Splints to be fastened immoveably upon a limb considerably larger than the size they were intended to fit,

when closed "home;" thus allowing them to be used as a primary Splint upon a swelled limb, and closed as the swelling subsides, when they will be used as the permanent Splint. They will even furnish an index when the swelling has entirely subsided; since fitting the limb at its normal size when closed "home," this closure "home" indicates that the limb has been reduced to its normal size. Similarly, when applied to a crooked limb the two features will indicate the complete cures, when they can be closed "home" without bearing painfully upon the prominent portion of the curve.

6th. They enable a patient to walk earlier on a fractured leg, or use a fractured arm earlier, than could be done safely without them. When a limb is fractured, nature forms a sort of a Splint, by throwing out, around the broken ends of the bone, a soft material, which hardens into something resembling bone; a spike of the same material also connects the broken ends within. These processes begin on the eighth day after the fracture as the average. It takes usually a month for the material, called the "callus," to harden so as to bear the weight of the person, if it be a leg broken, or to be carefully used, if an arm; but the bone is not yet "knit together." It is only now that this process begins; hence the frequency of refracture within two or there months. Now, if this can be obviated, time is saved and may be health. The Hard Rubber Splint, with graduated clasps, now adjusted "home," or as nearly so as the callus will allow, furnishes an additional callus, having as much lever advantage over the natural one, as it is the more removed from the centre of the limb, and securing by just so much, against the casualty of refracture.

7th. They may be used to compel a fractured leg to knit, in a class of cases where this fails and a false joint

is formed, for want of constitutional vigor to get up the healthy degree of inflamation in the fractured ends, requisite to carry on the process of uniting. In such cases, the indication is to improve the constitution by exercise, fresh air, and sunlight, without which, tonic remedial agents are likely to fail; and, to irritate the fractured ends of the bones by friction and pressing together. The former may be made practicable when the fracture is transverse and simple, (the only cases in which false joint is likely to occur,) by adjusting the Hard Rubber Splints with the graduated fastenings, and the latter secured at will by walking or standing on the limb.

8th. They may be used as a curative means for false joints, when actually established. False joints are constituted on the same general principles of construction, as the normal joints; they acquire the smooth surface of gristle, and are lubricated with the fluid (vulgarly called elbow grease) secreted by a proper sac thrown around the joints for the purpose, and even flange out or enlarge at the approximated surfaces, like proper joints. It is an axiom in the medical profession, that an organ or tissue not exercised in its proper use for a length of time, will degenerate. If these false joints are prevented from moving as joints for a length of time, they will obey the bent of nature in this direction; and if they are constantly made to bear the weight of the body by perpendicular pressure, at the same time that they are not allowed to exercise their function as joints, and this done in season before they have become matured, the newly formed joint tissue not having the vitality of seasoned tissue, will yield to the pressure, take on inflamation and become united, as the usual result to proximate surfaces when inflamed, this result being in effect a cure of the false joint. The Limb-Straighteners are, in construction, iden-

tically the same as the fracture Splints, with the qualification that they must be made of just such thickness as will allow them to exercise a spring bearing. This will be governed of course, by their length and circumference, whereas the fracture Splints may be made of any thickness dictated by economy and convenience of weight, beauty, &c. The Limb-Straighteners may have longitudinal slots or holes of any shape, if desired, to increase the springiness for a given thickness, and to afford ventilation to the skin ; this latter is also to be secured by wearing cotton, linen, or silk stockings next to the skin. The apparatus may be hidden from public observation by being covered with stockings outside when worn.

If the curvature of the crooked bone be so sharp as to render the pressure upon the skin painful, that part is to be padded accordingly before adjustment ; to avoid this in cases where the shin-bone arches forward, this shape may be imitated in the apparatus, (but it should be in less degree,) by building up the front of the plaster-bust upon which it is made ; those made for bow-legs do not need this alteration of the normal shape.

The advantages claimed for the Spring Hard Rubber Leg-Straighteners, over all other appliances for straightening crooked limbs, are shown in the following :

Hitherto no attempt has been made to remedy thie deformity, except by upright strips of tempered steel fastened to the bearings of the bone, to be straightened by means of leather straps and buckles, the spring of the steel being made to operate against the curve. The disadvantage of the appliance consists in its unsightliness, the constant tendency of the steel to work around and bear in the wrong direction, increasing the deformity if allowed ; its costliness ; its constant demand on the attention of the attendant, and the additional expense of a surgeon's super-

intendence. The writer has received a fee of ten dollars, cheerfully paid, for a single written prescription for the adapting of this apparatus, and in all candor, is at this day constrained to confess, that in his observation, it has proved virtually impracticable.

The Spring Hard Rubber Splint, with the graduated clasp is free from all these difficulties, and is, therefore, practicable in the hands of any nurse or parent who can be trusted with the responsibility of fitting a pair of shoes to a tender infant's foot, to the cure of thousands of bow-legs and otherwise crooked limbs, including what are called "willow stick fractures" in the young, (infant's bones never completely break,) which are now allowed to grow up into irremediable deformity, only because the mechanical demand to which they give rise had not been heretofore supplied.

*King's Knee-Cap Splint.*

This is a new invention entirely, the mechanical merits of which meet a demand heretofore keenly felt by the surgeon as well as the unfortunate patient concerned. Up to the date of this present writing, fracture of the knee-cap has been the opprobrium of fracture-surgery. To understand the chain of awkward consequences following upon this apparently insignificant accident, requires to look into the anatomy and philosophy of the parts. The knee-cap is not strictly a part of the bony frame-work which constitutes the skeleton proper, but an auxilliary growth within the conjoined tendon of the four powerful muscles which form the front of the thigh, where it passes over the knee principally to increase the leverage upon the lower leg-bone, into which the tendon is inserted, its action being to carry forward the leg. The knee-cap also furnishes a shield to the knee-joint; but unfortunately, when this shield is broken, the whole tendon is severed, and the whole powerful muscular apparatus having no longer any attachment, and therefore no resistance to its contractions, follows its natural tendency, and in doing so, of course, carries the upper fragment of the knee-cap up the front of the thigh, and holds it there. The muscles will never relax of their own accord, and unless the fragment be pulled down and held in its place, the only knitting that can take place is by a long ligament of non-fibrous tissue, thrown out between the two fragments; herein lies the dire consequence of this slight fracture; the front muscles of the thigh are thenceforth useless for locomotion, and the leg has to be thrown forward like a wooden leg, by the abdominal and hip muscles. This is usually the result, to a greater or less extent, of the very best treatment; for as a practical fact, there has been no apparatus devised for its prevention up to the present.

There is a beautiful little appliance of claws, which are fastened into the fragments and brought together by means of a thumb-screw; but, unfortunately, its pathological bearings are not as beautiful as the mechanical. The danger in converting a simple fracture into a compound one, which it almost necessarily does, by making holes through the skin to get to the bone, puts its use out of the question.

King's Splint for Fractured Knee-Caps accomplishes the end without wounding the soft parts, and thus meets the demand long sought. It is moulded to the shape of the knee, of hard rubber sawed into four branches. These hinge all together by a newly devised hinge—the Ring hinge—which allows the four to move in any direction; two of these clasp in front, according to the direction of the fracture. The patient is put under the influence of anæsthetics till the muscles cease all resistance; the whole apparatus is then brought into coaptation in front of the knee-joint, confining the knee-cap under it by virtue of adaptation to its exact form, and by the judicious administration of the new agent for quieting the system, (hydrate of chloral,) kept up for a few days, the bone is knit together as any other bone, all the circumstancial inconveniences of the usual result completely prevented, and the limb is afterwards as useful and as handsome as before the accident.

Another application of the Hard Rubber Splints in contemplation, is the straightening of club-foot. This disease is of four principal varieties: The foot is pulled forward, presenting the heel to the ground, or backward, presenting the toes to the ground, or to either side, presenting the other side to the ground. It is caused by paralysis of single sets of muscles of the leg, the foot being thus relaxed on the side in question, and the opposite

set, having no resistance, pull the foot to the healthy side.

The usual remedy for this disease is surgical, viz: Cutting the tendons of the healthy muscles, but this is unreasonable on its face, as it does not cure the paralysis of the affected muscles, but only seeks to prevent confirmed deformity of the foot, by virtually paralysing their opponents, and is at best, therefore, only a paliative measure.

The only rational measures are to address remedial medicines to the constitution, as the difficulty arises from constitutional causes; and in the meantime, prevent deformity by encasing the leg and foot in the light material, which is the subject of this paper, till the muscles recover tone and are able to do their own work.

MASON & CAMPBELL,
*Attoreys & Agents.*